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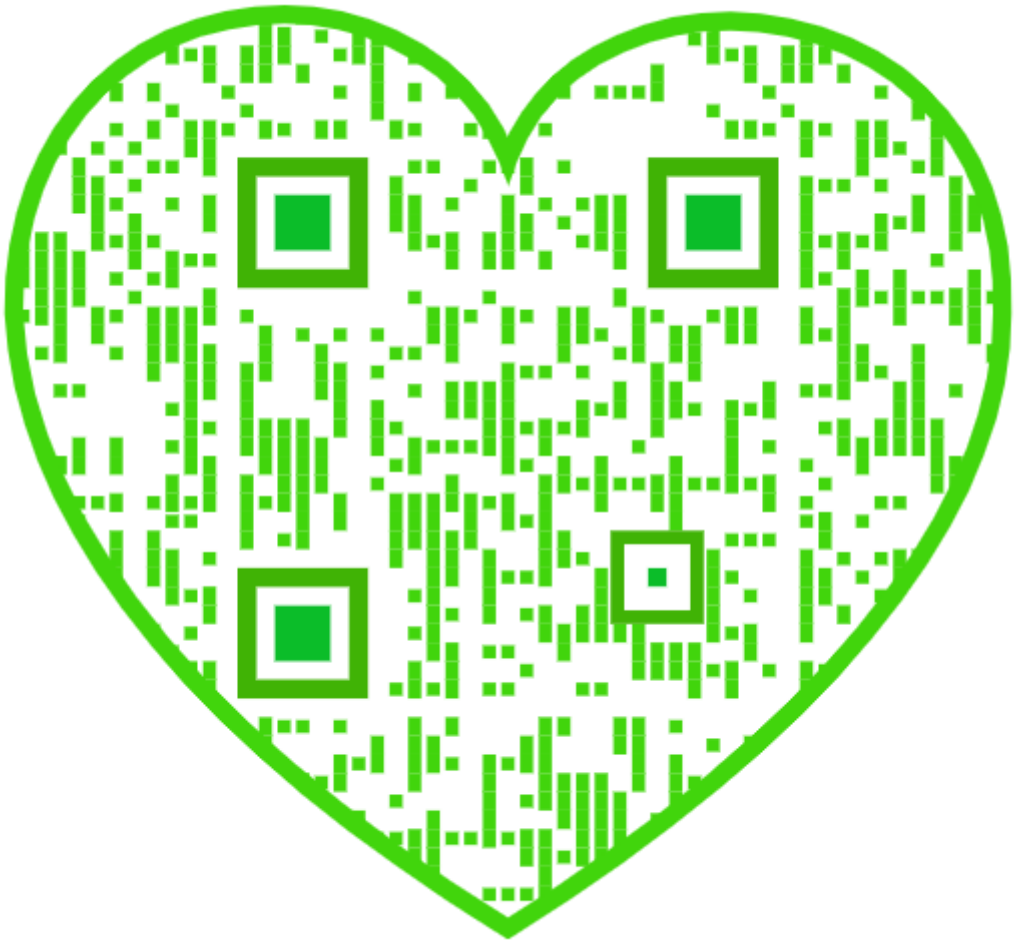

THE SEWAGE FARMS OF BERLIN

BY

ROBERT C. BROOKS

REPRINTED FROM POLITICAL SCIENCE QUARTERLY
VOL. XX, NO. 2

BOSTON
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TO its laurels as capital, metropolis and chief commercial center, Berlin adds the unusual distinction of being one of the largest landed proprietors and farmers in the German empire. The agricultural holdings of the municipality, 32,727 acres or 51 square miles in all, are now more than double the area of the city itself.[1] To say that Berlin is engaged in farming to this great extent "for its health" is no merely flippant expression, but the exact truth. A brief comparison with the conditions of thirty years ago will not only make this plain, but will also serve to show how fully the city has succeeded in its purpose.

In 1874 the sanitary condition of Berlin was more worthy of the eighteenth than of the nineteenth century. Open gutters, deep enough in places to deserve the name of ditches, were to be found throughout the greater portion of its built-up territory. Through these gutters the liquid filth of houses and streets, or rather such part of it as did not soak into the soil, found its way sluggishly into the river Spree. At places where danger threatened, rude coverings of timber or stone had been provided, with the result that the ditches beneath were made difficult of access and speedily became the worst plague-spots in the city.[2] As early as 1860 the consequences of such unsanitary conditions had been recognized officially, and during the succeeding decade various reform plans were discussed with more vigor than fruitfulness. Then came the Franco-Prussian war, at the end of which Berlin, suddenly elevated to the rank

[1] Verwaltungsbericht des Magistrats zu Berlin für das Etatsjahr 1902, no. 41: Bericht der Deputation für die städtischen Kanalisationswerke und Rieselfelder, p. i. This report covers the operations of the sewerage system and sewage farms for the year that ended March 31, 1903. Statistics quoted in the present article and not referred to any other source are taken from this or earlier reports of the same commission.

[2] Henry Vitztelly, Berlin under the New Empire (1879), vol. i, p. 15; Bericht über die Gemeindeverwaltung der Stadt Berlin in den Jahren 1861 bis 1876, zweites Heft, p. 125–128.

of a world city, began to grow with Chicago-like rapidity. Under the pressure of increasing population the inadequacy of existing sanitary arrangements became alarmingly manifest. It was generally recognized that nothing short of the most sweeping reforms, speedily carried out, could provide for the magnificent future before the now imperial city.

At this crisis Berlin was fortunate in the possession of two great masters of sanitary science, Rudolph Virchow and James Hobrecht. Virchow's fame as the foremost pathologist of the century was even then world-wide. In the midst of scientific investigations imposing an almost incredible burden of work he found time to serve his country as legislator in Reichstag and Landtag, and his city in the humbler but no less useful capacity of councilman. His epoch-making report to the Berlin council in 1872 laid bare with unflinching hand the sanitary dangers of the city's condition and demonstrated the absolute necessity of action. Virchow was able to show, for instance, that in the three periods of five years each preceding his report the general mortality of the city had advanced in the ratio of 5, 7 and 9. Nothing in existing conditions warranted the belief that the coming lustrum would not show a death-rate at least twice as great as that of the first period of five years. Indeed, the mortality of children had more than doubled within the preceding period of fifteen years, the ratios being as 5, 7 and 11.[1] During the years 1870, 1871 and 1872, the general death-rate of the city was 33.16, 40.44 and 33.28 per thousand, and from typhoid fever alone 7.7, 9 and 14 per ten thousand inhabitants.[2] These figures fitly reflect what was taking place within the metropolis —an increasing population crowded in unsanitary houses, a growing accumulation of dirt in the streets and squares, an ever greater amount of liquid filth running or soaking through the city's open gutters, a progressive poisoning of the sub-soil, and the defilement of the river Spree to the ultimate pollution of the sources of the city's water supply.

[1] James Pollard, A Study in Municipal Government: The Corporation of Berlin (1893), p. 35.

[2] Statistisches Jahrbuch der Stadt Berlin. Jahrgang xxvii, p. 88; Erläuterungen z. d. Modell v. d. Rieselfeld–Anlagen d. Stadt Berlin, p. 8.

Among the various plans proposed, Virchow's report favored that of the distinguished sanitary engineer, James Hobrecht. As early as 1860 the latter had been appointed member of a royal commission for the study of Berlin's sewage problem. In this capacity he had visited France and England as well as many German cities. Upon his return he undertook an exhaustive investigation of the conditions peculiar to Berlin.[1] The result was a plan, complete to the minutest detail, for the creation of pumping stations and sewage farms on a scale which made all earlier efforts of a similar character sink to the rank of mere experiments. Early in 1873 the city council accepted this plan, and Hobrecht immediately began to put it into execution. Starting in that year without a mile of what could properly be called underground sewers, before the end of 1876 the city had laid pipes connecting with 1000 lots. This number was increased to 7500 in 1880 and to 20,000 in 1890, by which time the whole city had been provided with a fairly complete network of sewers. Subsequent additions, due largely to the growth of the city, bring the total number of lots connected up to 28,000. The acreage of the sewage farms was necessarily extended with the growth of the sewerage network, until at present the municipality is in possession of seven large estates forming two fairly compact areas lying to the northeast and southwest of the city.

Twenty years from the installation of this new system of sewage disposal, Berlin had become one of the healthiest large cities in the world. The high general death-rates of the early seventies had fallen in 1894 to the very moderate figure of 21 per thousand, while typhoid was claiming only one per

[1] The results of the early studies of Hobrecht and other experts, among whom should be mentioned Virchow, Liebreich, Müller, Röder, Werner, Dünkelberg, Gerlach, Kunth and Lossen, may be found in the valuable collection entitled Reinigung u. Entwässerung Berlins; Einleitende Verhandlungen u. Berichte über mehrere auf Veranlassung d. Magistrats d. kgl. Haupt- u. Residenzstadt Berlin angestellte Versuche u. Untersuchungen (Berlin, A. Hirschwald, 1879). Hobrecht's later work describing the sewerage system after its completion is entitled Die Canalisation von Berlin (Berlin, Ernst u. Korn, 1884). It is the great authority on the technical side of the subject, and is supplemented by an atlas in large folio containing 57 tables illustrating the details of the system.

10,000 annually between 1890 and 1893. Not all the vast sanitary improvement indicated by these figures can be attributed to the new method of sewage disposal alone. Municipal management of the water-works from 1873 on, better methods of street cleaning, the abolition of dark and damp cellar-dwellings and, in general, more vigorous sanitary inspection undoubtedly contributed to the marked betterment of hygienic conditions. It must be admitted, however, that prior to 1893 the chief factor in the improved health of the city was the new sewerage system. M. Durand-Claye is authority for figures published in 1885 and representing the transition period, according to which there was one case of typhoid fever to every 9.3 houses, and one death from that cause to every 43 houses in the non-sewered districts of the city. In the sewered sections at the same time there was but one case to every 49.3 houses, and one death to every 137.5 houses.[1]

In 1893 Berlin secured new sources and began the installation of a greatly improved water supply system. The subsequent considerable decrease of the general death-rate and the reduction of the typhoid death-rate until at present it is only one-half of what it was ten years ago are more clearly attributable to this cause than to accompanying improvements and extensions in the sewage-disposal plant. Both causes, however, are undoubtedly operative to-day in keeping Berlin in the front rank, if not at the head, of metropolitan cities so far as sanitary conditions are concerned. Comparisons are proverbially odious, yet Chicago may perhaps forgive one to her disadvantage in exchange for an admission that she will probably soon outstrip Berlin in the race for population. In 1900 Chicago was in full enjoyment of the sanitary advantages accruing from the construction of the drainage canal and the disposal by this means of a large part of the city's sewage. How great these advantages were may be inferred from the fact that her typhoid death-rate for the years 1900, 1901 and 1902 was about one-fourth what it had been ten years earlier. Nevertheless Chicago's deaths from typhoid fever in these three years num-

[1] *Engineering News*, vol. xiv, p. 241 (Oct. 17, 1885).

bered 337, 509 and 801 respectively. For the same years Berlin lost only 109, 88 and 52 lives by this disease.[1]

The sewage-disposal plant, which thus stands a monument to the beneficent genius of Virchow and Hobrecht, is divided into two parts—the so-called radial systems in the city and the *Rieselfelder*, or sewage farms, lying at a distance of from two to eight miles from its periphery. Berlin, it should be explained, is located in the midst of an extensive sandy plain, a fact favorable enough so far as sewage cultivation itself is concerned, but presenting certain difficulties in the earlier stages of the work. The monotonous level of the city's floor necessitated its division into numerous districts, in order that the collection of sewage by gravity might be possible. There are some countervailing advantages in this arrangement, chief among which is that an accident in one radial system affects only a small part of the city. The cost of operation, however, is materially enhanced by the necessity of duplicating pumping-stations to force the sewage to the farms through pipes "radiating" from each district. There are at present twelve such districts or radial systems. Parts of three of these, however, represent territory lying in Charlottenburg and other suburbs, the sewage of which is disposed of at a fixed rate by the Berlin plant.

At approximately the lowest point of each of the twelve radial systems a pumping-station is located, to which pipes converge from all the baths, sinks, closets, drains, gutters and factories of the district. A visitor to one of these pumping-stations, expecting to find it the sink of all the abominations of a great city, will be most agreeably surprised. Instead, he will see prim walks, every brick of which might be used forthwith for scouring; tiny, well-kept flower beds bordering bits of close-cropped lawn; a neat cottage which serves as the official residence of the chief engineer of the station, and other smaller buildings containing lockers, baths, eating-rooms and rooms for the drying of clothes—everything in fact that can contribute to the comfort and cleanliness of the workmen. Towering

[1] Statistisches Jahrbuch d. Stadt Berlin, Jahrgang xxvii, pp. 103–111; Statistics of Cities, Bulletin of the Department of Labor, nos. 30, 36 and 42.

over all else in the enclosure is the massive structure sheltering the boilers, engines and pumps.

Descending into the sand-tank, the contrast with the cleanliness above strikes one forcibly enough. This is an enormous circular cistern nearly forty feet in diameter, into which the grand trunk sewer of the district empties its volume of gray, heavy, dully glistening fluid. The sand-tank is divided into two equal parts by an iron grating, the bars of which are separated by spaces of three-fifths of an inch. Owing to the size of this cistern the velocity of the flow of sewage is lessened on entering it, which permits the deposit of sand held in suspension. The bars of the grating catch and hold occasional rags, bits of paper, leaves of vegetables and other substances which might cause damage to the pumps. On a platform raised a few inches above the level of the sewage in the tank, a workman armed with pitchfork and shovel is constantly employed in removing the deposit of solid matter which is later carried off and burned with the city's garbage.

After passing through the bars of the sand tank the sewage is ready for the pumps. These are of enormous strength, capable of forcing the daily volume of the city's sewage, through cast-iron pipes thirty to forty inches in diameter, to the farms distant from six to sixteen miles and elevated from sixty-five to a hundred feet about the level of the city's floor. During the year ending May 31, 1902, the pumps of the twelve radial systems forwarded 83,721,323 cubic meters of sewage. The daily average of that year, about three hundred thousand cubic yards, would be sufficient to flood Central Park in New York to a depth of two and three-quarter inches. In periods of heavy rainfall very much larger quantities are pumped within twenty-four hours. At such times it is occasionally found necessary to allow part of the water clogging the sewers to escape into the Spree and its tributaries. This admitted defect of the system is due to an over-careful economy in installing the sewerage network, as a result of which some of the pipes were made too small for efficient service in a great emergency. In defence of the practice it is pointed out that the vents for the escape of the superabundant water are located at the top of the sewers, and

that in consequence of this arrangement only a very small percentage of the heavier excrementitial matter escapes with the overflow into the river. Fortunately the necessity of resorting to this dangerous device occurs rarely, and then usually lasts for a very short time.

The mains leading from the various pumping stations carry the sewage to the highest levels of the farms. Standpipes located at these points indicate the height and pressure of the fluid in the mains upon a scale outside, to the moving pointer of which a lantern is attached by night. Watched constantly by the foremen of the fields, this device serves to show when and in what quantities the sewage must be used. From the standpipe radiate networks of smaller pipes which carry the water to every part of the fields to be irrigated.

Of the total area of agricultural land owned by the city, slightly more than half, or about 17,000 acres, have been prepared for sewage farming. Part of the remainder is represented by recent acquisitions not yet adapted for irrigation and still under ordinary cultivation. The rest consists mostly of timber and waste land, roads and waterways. Preparation of the farms for sewage irrigation is a task of considerable magnitude. In its former state the land possessed hardly anything that could properly be called soil. The fields were nothing more than slightly rolling tracts of sand or very sandy loam of an average depth of between forty and sixty inches. An American farmer would not give a second look to such land, a French-Canadian would pass it with a shrug, and even a sand-hiller of the South would scorn to squat on it. Only by the most careful cultivation and the use of large quantities of artificial fertilizer were the original holders able to make it productive. Beneath the superficial layer of sand is a substratum of impervious clay. A sandy or gravelly soil is in general the most favorable for sewage farming, but in this case the depth of sand was hardly sufficient to prevent accumulations of foul fluids to such an extent as to render the land marshy and sour. This would have destroyed growing vegetation and threatened the health of the whole neighborhood. Consequently it was deemed necessary to provide at heavy expense a complete system of underdrainage.

The fields to which the sewage is applied are of two kinds, sloping and level. Comparatively little grading is required for the former; the chief inequalities of the surface are smoothed down, tiles are provided, and an open ditch is dug along the highest side of the field. This is filled to overflowing with sewage, which trickles down the incline and is absorbed. Such sloping fields are used for the most part as meadows. Italian rye-grass, the most successful of all sewage plants, is the principal product. On many of the better fields of the Berlin farms six or seven cuttings are taken annually, and the average yield per acre on the land used for this crop is twenty-two tons of grass of excellent quality per year, a marvellous result considering the nature of the soil.[1]

The level fields are graded until they are almost perfectly horizontal or are laid out in terraces—a tedious and costly operation, which, however, is somewhat facilitated by the sandy character of the soil. After having been smoothed off they are divided into tracts of an acre or less, each of which is still further subdivided into narrow strips or beds. A complete system of irrigation ditches large and small brings the sewage into contact with the sides of the beds. In no case is it allowed to touch directly the growing vegetation of the level fields. The sewage filters into the beds from the sides and reaches the roots only. In order that this action may be effective, the width of the beds is strictly limited, being ordinarily only forty inches. Considering the original character of the soil, a truly remarkable array of vegetation is brought forth luxuriantly on the level fields. Of grains there are wheat, rye, barley, oats, corn and rape seed; of vegetables, potatoes, beets, carrots, radishes and particularly every variety of cabbage dear to the heart of the *Hausfrau;* of fruits, strawberries, currants, gooseberries and raspberries. Medicinal herbs, hemp and nursery seedlings are other products. Roses whose exquisite scent strangely be-

[1] The grass is sold as it lies on the field immediately after being cut, bringing from 40 to 60 pfenninge per double hundred-weight in this form, or about $1.00 to $1.50 per ton. Owing to the large proportion of water contained in rye-grass, its conversion into hay is economically impossible, a fact which naturally detracts greatly from its value. *Cf.* J. W. Slater's Sewage Treatment, Purification and Utilization (London, 1888), p. 49.

lies their nurture are sold at good prices to Berlin florists by the enterprising gardeners of the sewage farms.

Owing to the small size of the beds in the level fields a large part of the work of cultivating them must be done by hand, or as the Germans somewhat more correctly say, "by the spade" (*Spatenkultur*). Most of the laborers live directly on the sewage farms, which have a permanent population of this character numbering about 3000, of whom 2100 are adults. Whenever necessary, as in harvest time, other laborers are temporarily employed, the men receiving from one and a half to two and a half marks, and the women eighty pfennigs to one mark a day. The permanent force is paid at even lower rates, but the difference is more than made up by the free rental of cottages, payments in kind and the privilege of cultivating small pieces of ground. Skilled workers, such as nurserymen and foremen, get two and three marks a day. The piece-work method is often employed, and under it the men are said to earn from twenty to fifty per cent. more.[1] Taking into consideration the great amount of common labor necessitated by sewage farming, it would seem that Europe has a decided advantage over America in the cheapness and abundance of its supply.

In addition to the free laborers employed on the Berlin farms, there are always from seven to eleven hundred workhouse prisoners, mostly beggars, vagrants and tramps arrested in the city, who are forced to work out their sentences in the fields. The sewage farms thus provide simple, open-air employment to an almost unlimited extent for a class of persons whose maintenance in institutions would not only be less satisfactory from a sanitary point of view, but would also cost the city more than under the present arrangement. Worked in gangs, housed in cheerless barracks, clothed in uniforms of rough brown cloth and sparingly fed, these *Arbeitshäusler* of the sewage farms nevertheless seldom attempt to escape, partly because it is practically impossible to avoid being caught within a few days, and partly because they prefer working outdoors for Berlin to imprisonment in other places. Although short-term prisoners exclusively, there are not a few among them who con-

[1] *Annales des ponts et chaussées*, 7 série, tome x, p. 283 (1895).

trive to be sent back time and time again until they become almost as permanent as the regular employees. Thus by a sardonic but truly poetic justice the sewage of a great city and its human riff-raff are forced to work out their salvation together.

Shortly after the feasibility of sewage irrigation had been demonstrated under municipal management the city received numerous applications from tenant farmers who wished to rent small tracts of land with the privilege of using the sewage as fertilizer. About 2100 acres are now rented in this manner; the remainder, or about seven-eighths of all the land adapted for sewage cultivation, is farmed directly by the city. It has been the policy of the municipality throughout to insist not only upon municipal ownership, but also upon municipal management or at least the strictest sort of municipal control of the sewage farms. The sanitary welfare of the city is recognized as vastly more important than any purely economic interests involved. For this reason public operation under responsible officials is preferred as a general rule. In the leases under which the tenant farmers operate, it is also the practice to provide every precaution against carelessness in the use of the liquid fertilizer, and these conditions are carefully enforced by administrative supervision.

Sewage is at best a word of sinister significance, and sewage farms—though they grow roses—will hardly find employment in poetic metaphors as places suggestive of sweetness and purity. Yet one might travel for miles over Berlin's landed estates without encountering a single unpleasant odor unless he chanced upon an open hydrant. After the water is released and distributed over the fields it quickly loses its offensive character, no matter how foul it may have been on issuing from the pipes. Sewage coming from different parts of Berlin varies greatly in color and composition, and likewise in offensiveness and fertilizing power. Thus the sewage from a radial system occupied largely by workingmen, to whom bath tubs are unknown luxuries and who economize strictly in the use of water under the stress of the meter system employed in Berlin, is foul and inky on arriving at the farms. Consequently it is much more welcome to the cultivators than the

colorless and almost odorless water from the district south of the *Thiergarten* where wealth and bath tubs abound. This point is worthy of note by American municipalities contemplating sewage farming. Owing to the much larger per capita use of water in this country the sewage of our cities is considerably less valuable for agricultural purposes than is the case in Germany.

More important than the outward inoffensiveness of the sewage farms is their sanitary condition. Is this method of disposing of the liquid waste of a great city simply a device whereby the health of hundreds of thousands is preserved at the sacrifice of the health of hundreds living on the farms or in their neighborhood? The formula of the greatest good to the greatest number might cover such a case, but there is no need to invoke the shade of Bentham here. It may be asserted most confidently that the average health of the population on and in the immediate neighborhood of the sewage farms is as good as that of other rural communities in Prussia. Moreover, the danger of epidemics is probably less than in communities of equal size in Prussia or elsewhere, certainly less than in many American cities at the present time. The explanation of this apparently extreme statement may be found in the great and constant care with which the pathological phenomena of the sewage farms are studied. Other things being equal, that community is best safeguarded against epidemics where they are most feared and where the most thorough preparations are made to prevent them. Such a community may be found upon the Berlin sewage farms. Probably no rural population in the world has more intelligent care expended upon the preservation of its health—surely a valuable asset against any special liability to disease to which it may be exposed. A glance at the statistical tables which the municipal government publishes annually and which deal with cases of sickness and death on the sewage farms will go far in support of this statement. From the same source one may learn also of the frequent analyses of the water of the wells used by the sewage farmers. The effluent from the fields, gathered first by the tiles underlying them and carried off by open trenches to

neighboring water courses, is likewise made the subject of careful and constantly repeated examinations. Almost invariably it is found pure, clear, odorless and practically free from micro-organisms. Countless tests of the effluent have failed to show the presence of typhoid bacilli in a single instance. The least evidence of a taint of any sort is followed by a searching investigation which does not stop until the cause has been discovered and removed. Similarly with any suspicious case of sickness occurring on the estates. From 1893 to 1903 there was an average of only one and a half cases of typhoid fever a year on the sewage farms; and during three successive years in this period, 1894, 1895 and 1896, not a single case was reported. Careful investigation in every instance failed to establish any connection between the disease and the water of the farms. As regards other epidemic diseases equally favorable results are shown. This record effectually disposes of the argument that flies would spread broadcast disease-germs obtained from the sewage distributed openly over the surface of the land. While the possibility of the transmission of pathogenic organisms in this way is fully established, the practical danger, judging from Berlin's farming experience, is very slight.

The perfect confidence of the municipality in the sanitary security of the sewage farms is shown by the fact that it has erected on four of the estates homes for the benefit of patients sent out from hospitals in the city. One of these is designed for convalescent women, particularly those recovering from maternity cases, another for convalescent men, and the remaining two for consumption cases. The city manages the homes directly, charging rates sufficient to pay expenses. In no sense, therefore, may the patients be classed as paupers remaining upon the farms because they have nowhere else to go. Over two thousand persons are cared for annually by the four homes, and there is always a large waiting list—facts which speak well for the public confidence in the sanitary condition of the sewage farms and in the management of the institutions for convalescents located upon them.[1]

"Paris casts twenty-five millions of francs annually into the

[1] Statistisches Jahrbuch d. Stadt Berlin, Jahrgang xxvii, p. 460.

sea." With this text Victor Hugo begins his wonderful description in *Les Miserables* of the sewers of Paris. Whatever may be the literary quality of these chapters—and who has not thrilled at the adventures of Jean Valjean?—they certainly convey a most ludicrously inaccurate idea of the value of sewage. It is easy to ascertain the amount of fertilizing ingredients contained in a city's liquid refuse and to multiply this by market prices, but the result is no more indicative of the real value of the sewage than would be a calculation of the value of the gold in a given ore regardless of the cost of extracting it. Berlin's practical experience on this point is obviously more conclusive than any quantity of statistics which soar into the millions unhampered by facts.

With fair natural conditions for sewage farming, with a large supply of cheap labor easily obtainable and with the most capable and honest of administrators, it must nevertheless be confessed that the purely financial results obtained by the German capital do not bulk large among the advantages of its system. Disregarding all interest charges and assuming the sewage to be laid down free of cost in the fields, the total value of farm products for the fiscal year ending March 31, 1903, exceeded the actual running expenses of 2,871,517 marks by 231,394 marks.[1] This was the most favorable showing made since 1892. Indeed, during four years of the decade ending in 1903, deficits had to be met as the result of current operations on the estates regardless of all other expenses. The average annual profit between 1893 and 1903 was only 33,442 marks. Looking solely at the result of current operations on the farms, then, it may be said that they usually yield a small sum clear of expenses.

The foregoing figures, however, take no account of the heaviest charges incident to Berlin's method of sewage disposal.

[1] This net profit of 231,394 marks includes an item of 148,497 marks which represents the increase during the year 1902–03, as shown by the inventory, in the value of seeds, tools, materials, *etc.*, on hand. The remaining figures quoted in the above paragraph also include these items and are therefore strictly comparable with the figure first given. As such estimates of increase or decrease are carefully made and as they are by no means always favorable to the management of the farms, there would seem to be no reason to exclude them.

First among these should be mentioned the current cost of operating the radial systems in the city, amounting for the year ending March 31, 1903, to close upon one and a quarter million marks. Even more important are the interest charges. The total permanent investment in the whole sewage-disposal plant of Berlin amounted, at the end of the fiscal year 1902–03, to 126,000,000 marks, of which three-fifths is debited to the works in the city and the remainder to the farms. By the operations of the sinking fund the amount of debt outstanding has been reduced to 96,000,000 marks, on which, in 1902–03, the city paid interest amounting to 3,368,000 marks. Adding to the above figures a number of smaller items of expense, the financial results of the Berlin system for 1902–03 may be summed up in the statement that it cost the city 7,974,000 marks to raise crops valued at 2,954,000 marks.

In the most favorable year of a decade, then, the operations of the Berlin plant as a whole resulted in a deficit of 5,020,000 marks. As the city paid 2,800,000 marks into the sinking fund in 1902–03 the total amount required for that year was 7,820,000 marks. This came principally from a special sewerage tax of one and one-half per cent of the rental value of real estate, which yielded 6,020,000 marks. Fees and other small items brought in 220,000 marks. The deficit of 1,580,000 marks which still remained was met directly by the municipality.[1] Owing to the favorable results on the farms in 1902–03 this contribution was considerably smaller than usual. As the city enjoys certain distinct advantages from the sewage-disposal system in the removal of rain-water from the streets and liquid wastes generally from public buildings and public comfort stations, these direct payments are fully justified, although, of course, in the last analysis the money comes out of the pocket of the taxpayer.

Berlin's balance sheet shows conclusively that something more than sewage is required to make sand Pactolian. Indeed there

[1] Exactly 1,577,161.58 marks in cash. If the increase for 1902–03 in the value of goods on hand as shown by the inventory be allowed (see preceding note), the real deficit left to be met by the city would be reduced by 148,497 marks and would thus stand at 1,428,664.58 marks.

are certain difficulties inherent in cultivation of this sort which easily explain the financial results detailed above. Some limitations are placed upon the rotation and selection of crops by the peculiarities of sewage farming. With so large an estate it is at times difficult, even in so great a market as that of Berlin, to dispose favorably of certain crops, especially of small fruits. A large standing force of workmen must be employed day and night at all seasons. The most important handicap, however, is the necessity of disposing of all the sewage even when it is harmful to vegetation. A hard rain in Berlin usually means a hard rain on the farms as well, but the latter are obliged to dispose of the double dose in a very short time. If relief from such excessive irrigation be sought in an extension of the area of the sewage farms, new difficulties arise. Despite its poor quality the land suitable for this purpose is costly, since it must be located near the city and must possess special advantages with reference to surface, elevation and drainage. On an average the city paid about $220 an acre for its present holdings, while the necessary work of grading, drainage, *etc.*, brought this up to about $395 an acre. Taking all these limitations in connection with the present depressed condition of agriculture in Germany, the exceedingly modest returns obtained from the sewage farms are not difficult to understand.

While Berlin's experience has failed to realize the dreams of sewage enthusiasts of the Colonel Sellers type, it would be far from the truth to assume that her system has proved a disappointment to those responsible for its foundation. Let it be remembered that if the city did not dispose of its liquid refuse by irrigation it would have to do so by some other method, probably clarification and chemical treatment. A comparison made a few years ago between Berlin and a number of German cities which had adopted the latter method showed that on a per capita basis the metropolis was serving its people at a much lower rate than any of the others. Even should the sewage farms have to be abandoned for a more efficient system at some future date, the city will possess in its land a large asset, the value of which is rapidly advancing. On the other hand, should science develop nothing better, the municipality

may congratulate itself on what few metropolitan cities possess at the present time, namely, an entirely satisfactory method of sewage disposal capable of indefinite expansion with the growth of its population. In the final analysis the purely financial results of the Berlin system are of minor importance. Its heaviest dividends are paid in cleaner, healthier, longer lives to two million people.

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POLITICAL SCIENCE QUARTERLY.

A Review devoted to the historical, statistical and comparative study of politics, economics and public law.

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